

Iridaceae from Serra dos Piraneus, Goiás, Brazil

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Abstract: We present an inventory of Iridaceae species from Serra dos Piraneus, a mountain range with several distinct vegetation types within the Cerrado biome and situated in the mid-east region of Goiás state, Brazil. The samples were collected *insitu* and surveys of herbaria were conducted. We found nine species of Iridaceae on Serra dos Piraneus, belonging to the following genera: *Cipura*, *Gelasine*, *Sisyrinchium*, *Sphenostigma* and *Trimezia*. This study provides a list of all species of Iridaceae recorded in this area including a brief diagnosis, a taxonomic note on *Sphenostigma polycephalum*, an identification key and an illustrated guide of Iridaceae.

Key words: Cerrado; checklist; monocots; *Cipura*; *Sisyrinchium*; *Sphenostigma*; *Trimezia*

INTRODUCTION

Iridaceae is a family of monocotyledons, belonging to the order Asparagales. The family is monophyletic and can be morphologically distinguished by vegetative and reproductive features, including their ensiform and unifacial leaves, flowers with a petaloid perianth bearing three stamens and inferior ovary and scattered cells containing styloids or cuboidal calcium oxalate crystals in most organs (Goldblatt and Manning 2008; Simpson 2010).

Widespread all over the globe, Iridaceae comprises ca. 66 genera and more than 2,000 species, in seven subfamilies (Goldblatt et al. 2008). In Brazil, there is only one subfamily, Iridoideae, with 23 genera and 190 species, mostly distributed in Atlantic Forest, Cerrado and Pampa biomes (Eggers et al. 2016).

The Cerrado, also known as the Brazilian savannah, is mainly located in the Central Brazilian Plateau and is the second largest biome in Brazil. This biome covers two million square kilometers, representing 21% of the Brazilian territory and is considered a hotspot area for priority conservation (Klink and Machado 2005).

Remaining Cerrado areas have decreased over the years, mainly for agricultural expansion, intensified since the 1940s, due to the construction of Brasília, the new capital of Brazil, in 1960 (Pedroso 2004; Miziara and Ferreira 2007; Bastos and Ferreira 2010). In the state of Goiás, for example, native vegetation covers is less than 50% of its original extent; this is worrying because current studies indicate that these natural environments are very susceptible to degradation (Klink and Machado 2005; Rocha et al. 2011). Therefore, biodiversity studies of the Cerrado are one of the most urgent topics on the agenda for conservation biology.

Iridaceae, with three representative genera, *Cipura* Aubl., *Sisyrinchium* L. and *Trimezia* Salib. ex Herb., is commonly found in Cerrado environments. *Cipura* is a small genus of the Neotropics, with ca. 8 spp. (Celis et al. 2003); *Sisyrinchium* is the largest genus found all over the Americas (Chauveau et al. 2011; Karst and Wilson 2012) with an estimated 140 spp. (Goldblatt and Manning 2008); and *Trimezia* is distributed from Paraguay to Mexico (Chukr and Giuliatti 2008) with ca. 20 spp.

This paper provides a complete list of Iridaceae species recorded from an area of preserved Cerrado in the Serra dos Piraneus, Goiás state, Brazil. An identification key, diagnoses, habitat information, and photographs are presented, making this a database for further studies and a field guide.

MATERIALS AND METHODS

Study site

The Serra dos Piraneus (SDP) is located in the municipalities of Pirenópolis, Cocalzinho de Goiás and Corumbá de Goiás (15°40' S, 048°45' W to 15°45' S, 048°50' W), in the state of Goiás. The minimum altitude is 700 m in Pirenópolis city and the maximum is 1,385 m on Pico dos Piraneus (Figure 1). According to the Köpper-Geiger classification, the region climate is type Aw (Kottek et al. 2006), with annual average rainfall

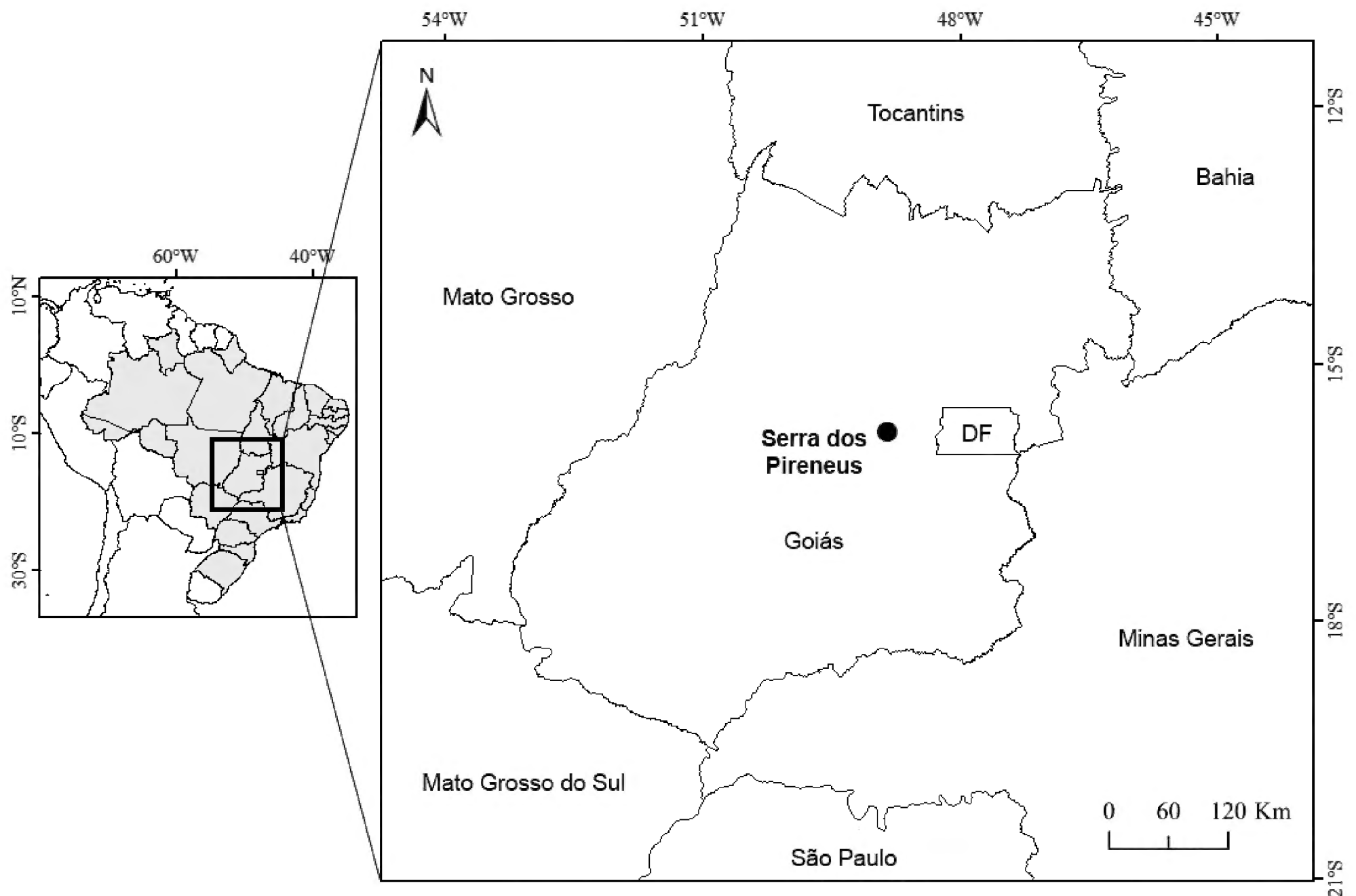


Figure 1. Map showing the location of Serra dos Pireneus, in the state of Goiás, Brazil. DF – Federal District.

of 1,535 mm and annual average temperature of 23°C (INMET 2015). Several typical Cerrado vegetation types occur in SDP, described in detail in Table 1.

Part of the SDP is protected by law within the Natural State Park of serra dos Pirineus. However, this protected area has been subjected to many anthropogenic influences, because all areas of the SDP have touristic, folkloric and religious sites, and there is also intense quartzite mining activities (Siqueira 2004; Bosquetti 2008).

Data collection

Field trips were carried out in various months from 2007 to 2012 in order to locate individuals and observe them in their natural habitats. Collected specimens were deposited at the herbarium UFG. Collections from the herbaria CEN, FLOR, HEPH, HTO, HUEFS, HUEG, HUTO, IBGE, NY, RB, SP, SPF, UB, UFG, and UFRN were also studied. Acronyms are according to Thiers (2016).

Morphological and ecological information were extracted from collected materials from the SDP. Additional materials, when necessary, are properly referenced. The SpeciesLink database was used to assemble a family histogram chart for the study area, including the mean precipitation, along the years (CRIA 2016; INMET 2016). An identification key is

here provided. The specimens were identified using specialized literature (Celis et al. 2003; Chukr and Capellari Jr. 2003; Chukr and Giulietti 2008; Eggers 2008; Goldblatt and Manning 2008). The descriptions of genera and the nomenclatural terms used were adapted from Goldblatt and Manning (2008) and Harris and Harris (1994).

RESULTS

There are nine species of Iridaceae in the SDP, belonging to three tribes (tribe Sisyrinchieae: *Sisyrinchium*, 1 sp.; tribe Tigridieae: *Cipura*, 3 spp., *Gelasine*, 1 sp., *Sphegnostigma*, 1 sp.; and tribe Trimezieae: *Trimezia*, 3 spp.).

These species occur mostly on 'campo limpo' vegetation, sometimes also growing in forested environments (Table 2). Species abundance varies across the seasons, and reproductive organs are more common during the rainy season (Figure 2).

Key to species of Iridaceae from the Serra dos Pireneus, Goiás, Brazil

- | | | |
|----|---|---|
| 1a | Underground system a bulb; leaves plicate | 2 |
| 1b | Underground system a rhizome or a corm; leaves linear or terete | 6 |
| 2a | Flowers yellow | 3 |
| 2b | Flowers blue or lilac | 4 |

Table 1. Vegetation description found on serra dos Pireneus, Goiás State, Brazil.

Vegetation	Acronym	Description	Representative taxa	Reference
Campo limpo (open grassland)	CL	Grassy layer with rare subshrubs or sparse bushes. No woody elements.	<i>Abolboda</i> , <i>Bulbostylis</i> , <i>Syngonanthus</i>	Ribeiro and Walter (2008)
Campo rupestre (rocky grassland)	CR	Herbaceous layer and some subshrubs and scandent vines/lianas covering shallow soils, often sandy and quartz. Rock outcrops present.	<i>Paepalanthus</i> , <i>Tibouchina papyrus</i> , <i>Roupala montana</i> , <i>Vellozia</i>	Vasconcelos (2011)
Campo sujo (dense grassland)	CS	Dense grassy layer and rare trees or small shrubs.	<i>Microlicia</i> , <i>Xyris</i>	Ribeiro and Walter (2008)
Campo úmido (floodplain grassland)	CH	Grassy layer composed by many herbs. Water table rises during the rainy season and it is often waterlogged, falling drastically during the dry season.	<i>Burmannia</i> , <i>Curtia</i> , <i>Gelinsea</i> , <i>Esterhazia</i> , <i>Habenaria</i> , <i>Schultesia</i> , <i>Utricularia</i>	Ratter et al (1997); Batalha et al. (2005)
Cerradão (xeromorphic forest)	CE	Forest vegetation, with abundant litterfall and a dense canopy. Plants are usually sclerophyllous.	<i>Copaifera langsdorffii</i> , <i>Davilla</i> , <i>Physocallima scaberrimum</i>	Ribeiro and Walter (2008)
Cerrado stricto sensu (wooded grassland)	CT	Forest vegetation, with grassland characteristics and marks of fires. Trees are small, tortuous and twisted, shrubs and subshrubs are sparse, some species present perennial rootstock (geoxyle).	<i>Annona coriacea</i> , <i>Caryocar brasiliensis</i> , <i>Qualea grandiflora</i> , <i>Tabebuia ochracea</i> , <i>Zeyheria digitalis</i>	Dixon et al. (2014); Ribeiro and Walter (2008)
Mata de galeria (gallery forest)	MG	Forest vegetation, along a river margin. Plants are usually tall forming a dense canopy.	<i>Hirtella</i> , <i>Hygrophila</i> , <i>Piper</i> , <i>Psychotria</i>	Ribeiro and Walter (2008)
Vereda (palm swamp)	VE	Swampy or waterlogged areas with springs on hydromorphic soils, always characterized by the presence of Arecaceae species.	<i>Mauritia flexuosa</i> , <i>Attalea</i> , <i>Rhynchospora</i> , <i>Syngonanthus</i> , <i>Xyris</i>	Bastos and Ferreira (2010)

Table 2. Species of Iridaceae from SDP and their respective vegetation occurrences. For vegetation acronyms and description consult Table 1.

Taxa	Vegetation
<i>Sisyrinchium marchio</i>	CL, CR, CS, CH, CE, CT,VE
<i>Cipura Formosa</i>	CR, CH
<i>Cipura paludosa</i>	CL, CR, CH, CS
<i>Cipura xanthomelas</i>	CL, CR, CH, CE, MG
<i>Gelasine coerulea</i>	CR, CS
<i>Sphenostigma polycephalum.</i>	MG
<i>Trimezia cathartica</i>	CL, CR, CH, VE
<i>Trimezia juncifolia</i>	CL, CS, CR, CH, VE
<i>Trimezia lutea</i>	CE, MG

- 3a Markings on tepals *Cipura xanthomelas*
- 3b Without markings on tepals
..... *Sphenostigma polycephalum*
- 4a Markings all over the tepals 5
- 4b Markings only at the base of inner tepals
.....*Gelasine coerulea*
- 5a Inner tepals imbricate, conivent *Cipura paludosa*
- 5b Inner tepals patent, revolute *Cipura formosa*
- 6a Underground system as a corm; tepals unequal,
with markings 7
- 6b Underground system as a rhizome; tepals equal or
subequal, without markings
..... *Sisyrinchium marchio*
- 7a Terete leaves 8
- 7b Linear leaves *Trimezia lutea*
- 8a Flowering stem aphyllous *Trimezia juncifolia*
- 8b Flowering stem with two imbricate bracts, close or
in the median region *Trimezia cathartica*

Tribe Sisyrinchiae

Sisyrinchium L. (Linnaeus 1753: 954).
Sisyrinchium is the largest genus of Iridaceae in the New World (ca. 140) and is quite different in its morphology. Typical rhizomatous herbs, bearing flat or cylindrical leaves and flowers usually with subequal tepals, ranging from white, purple, blue and yellow. Filaments fused at some point, bearing or not trichomes. Style partially fused, with three branches.

Sisyrinchium marchio (Vell.) Steud. (Vellozo 1827: t. 1; Steudel 1841: 596).
Figures 3 and 4

Diagnosis: Plants 10–50 cm height, sometimes prostrated on vegetation, bearing a rhizome. This species lacks true leaves but has a flowering stem with many cultriform, imbricate and alternate bracts. The flowers are yellow and tepals are equal or subequal, showing no marks or spots.

Ecology: *Sisyrinchium marchio* usually occurs isolated or with a few clustered individuals. Blooming from the beginning until the end of rainy season (October to May), one or two flowers at the same time per plant.

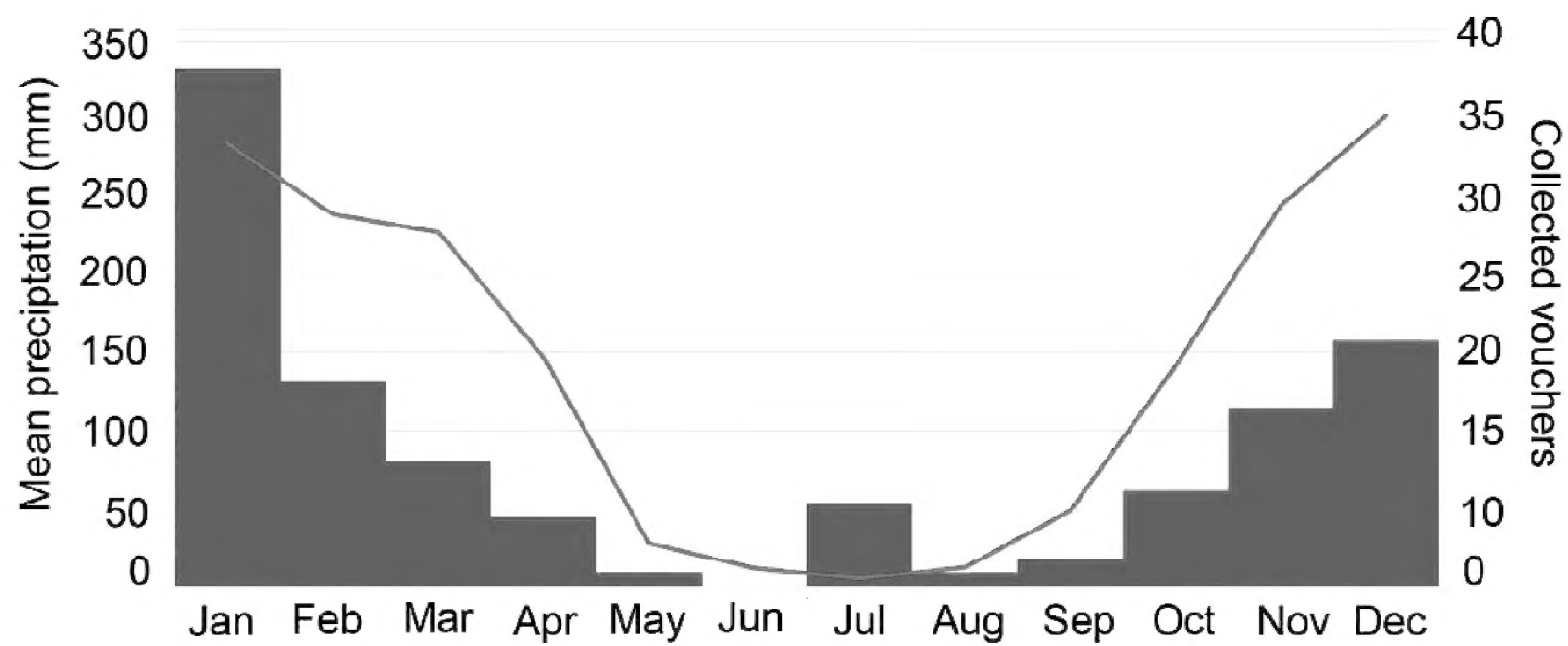


Figure 2. Histogram of all collected vouchers of Iridaceae with reproductive organs along the years 1900–2012 (blue bars, right) and the mean precipitation on Serra dos Pireneus, in mm (orange line, left).



Figures 3 and 4. Sisyrrinchieae from Serra dos Pireneus, Goiás state, Brazil. *Sisyrrinchium marchio*. **3.** Inflorescence and cultriform alternate bracts on the flowering stem. **4:** Flower overview. Photos by J.D. Medeiros and R.D. Sartin.

Selected examined material: Irwin HS 34442 (NY 910524); Irwin HS 18557 (NY 679971); Paula-Souza J 8456 (SPF 182423); Dantas-Queiroz MV 01 (UFG 46506); Gomes-Klein VL 67 (UFG 16114).

Additional material examined: Cavalcanti TB 455 (CEN 13486); Skorupa LA 123 (CEN 14697); Paula-Souza J 8368 (SPF 181974); Rizzo JA 3149 (UFG 940).

Tribe Tigridieae

Cipura Aubl. (Aublet 1775: 38, t. 13).

The genus *Cipura* has about eight species, distributed in Central and South America. Their members have bulbous rootstock, plicate leaves, erect or reflexed, and a large bract inserted at the cylindrical flowering stem apex. Flowers are yellow, lilac, purple, blue or, sometimes, white. The inner tepals are smaller than the outer. Stamens are free or sometimes proximally fused and the styles are thickened.

Cipura formosa Ravenna (Ravenna 1988: 36–37).

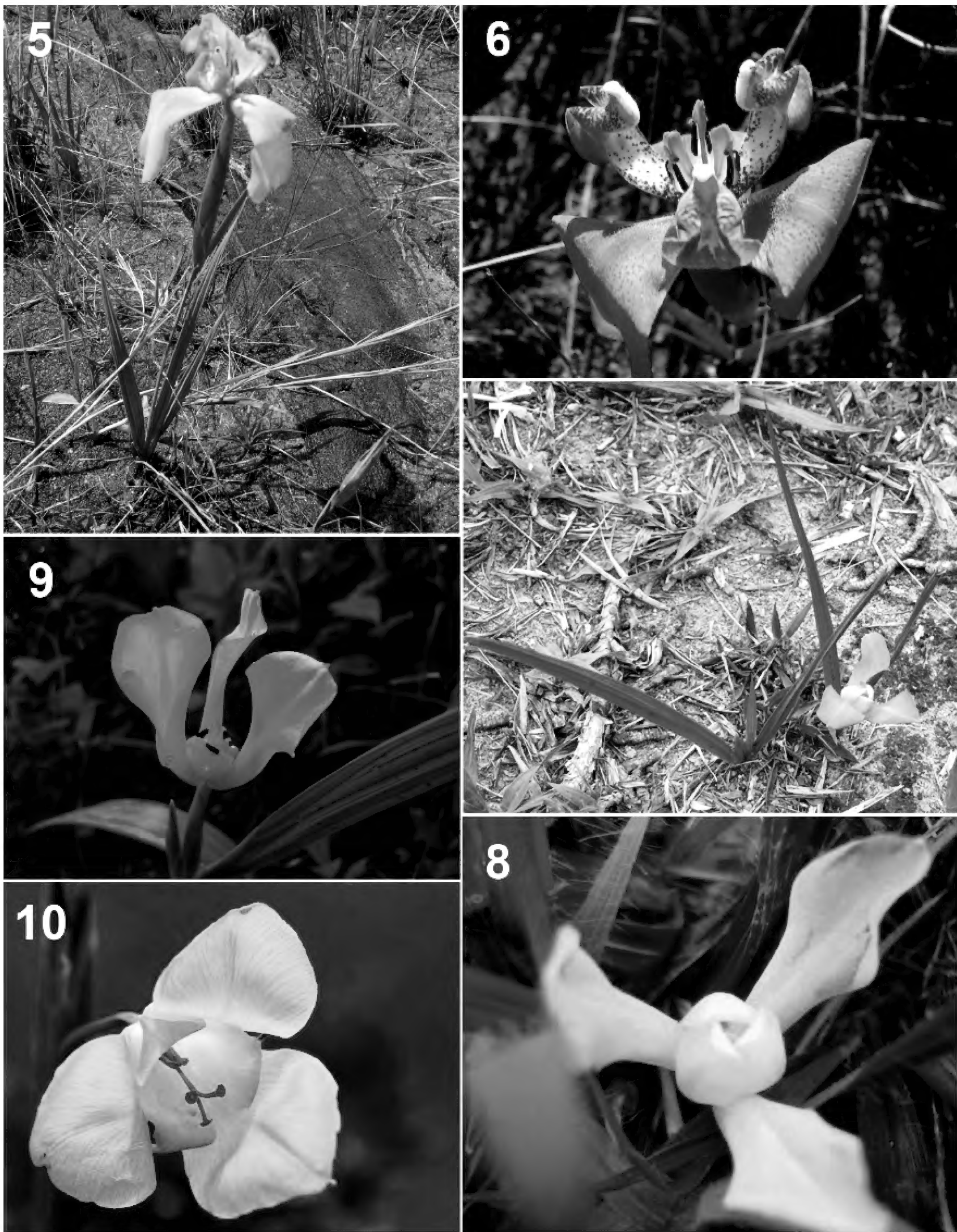
Figures 5 and 6

Diagnosis: Plants 30–45 cm height. This species has a resiniferous bulb, usually with encrusted rocks on its surface and rigid erect leaves. The flowers are showy, lilac or violet. The outer tepals are reflexed, with small purple dots, while the inner tepals have a white claw (the lower portion) with the upper portion presenting a limb that curves forward over the claw, with a yellow spot, and then is rolled outward distally.

Ecology: This species is found in medium to large populations, rarely isolated. Blooming on rainy season (January to May); only one flower at a time per plant.

Selected examined material: César R 72 (UFG 15614); Dantas-Queiroz MV 11, 37 (UFG 46516, 46536).

Additional material examined: Walter BMT 3640 (CEN 31785).



Figures 5–10. Tigridieae from Serra dos Pireneus, Goiás state, Brazil. **5 and 6:** *Cipura formosa*. **5:** Habit. **6:** Flower. **7 and 8:** *Cipura paludosa*. **7:** Habit (Photo by Cecilions). **8:** Flower. **9:** Flower of *Cipura xanthomelas*. (Photo by R. D. Sartin). **10:** Flower of *Gelasine coerulea*. (Photo by T. Philip).

Cipura paludosa Aubl., (Aublet 1775: 38, t. 13).

Figures 7 and 8

Diagnosis: Plants ca. 10–30 cm height, with often reflexed leaves. Flowers are pale-blue, rarely whitish. The outer tepals are erect, and the inner tepals are imbricate and conivent, hiding the androecium and gynoecium.

Ecology: Occurs isolated, rarely forming large populations. This species is found in open vegetation and also in anthropic areas. Blooming on rainy season (January to April); one or two flowers at a time per plant.

Selected examined material: Dantas-Queiroz MV 04 (UFG 46509).

Additional material examined: Walter BMT 1179 (CEN 17001); Alvarenga D 171 (UB 5731); Pirani JR 1911 (CEN 21315).

Cipura xanthomelas Klatt (Klatt 1882: 362).

Figure 9

Diagnosis: Plants with highly variable height, 10–60 [–100] cm. Leaves reflexed or erect, resembling the first

leaves of some Arecaceae. Flowers yellow, with patent outer tepals and erect inner tepals, with dark markings on their apex.

Ecology: Often isolated or few individuals close to each other. Also found growing in pastures and close to human habitations. Blooming on rainy season (November to March), usually one or two flowers at the same time per plant.

Selected examined material: Nogueira E 63 (UB 122850); Irwin HS 34081 (NY 910424); Barbosa A 3966, 4924 (UFG 4980, 5795); César R 360 (UFG 19252); Dantas-Queiroz MV 02 (UFG 46507); Gomes-Klein VL 2958 (UFG 17487); Monteiro CH 112 (UFG 16752); Rizzo JA 4721, 5676 (UFG 4980, 5795).

Gelasine Herb. (Herbert 1840: t. 3779).

This genus, comprising ca. six species, is distributed throughout South America. The rootstock is a bulb and their leaves are ensiform and pleated. Flowers are usually blue or lilac, with sepals subequal, the inner smaller than the outer. The stamens are adpressed to the style branches, these with the same size or exceeding the height of the anthers.

Gelasine coerulea (Vell.) Ravenna, (Vellozo 1829: t. 66; Ravenna 1977: 8).

Figure 10

Diagnosis: Plants ca. 80–100 cm height, with erect leaves. The inflorescence is congested and flowers are blue or lilac, with outer tepals larger than inner tepals and markings only at the base of tepals. Fruits are narrow-oblong.

Ecology: Usually associated with tall grasses. A very rare species to be observed at SDP, found with the flower opened only in the morning. Observed isolated and blooming in February, only one flower at a time per plant. Fruits were observed from January to April.

Selected examined material: Irwin HS 19273 (NY 00917379); César R 353a (UFG 18053); Dantas-Queiroz MV 06, 97 (UFG 46513, 46606); Gomes-Klein VL 2348a (UFG 15016).

Additional material examined: Irwin HS 12551 (NY 00917375).

Sphenostigma Baker (Baker 1877: 76).

Sphenostigma comprises ca. 10 species, distributed from the USA to South Brazil, Uruguay, and Argentina. These herbs have a rootstock bulb, ensiform and pleated leaves. Flowers are very fugacious, varying from blue to yellow, with free tepals, more or less subequal. Anthers are larger than the filaments; style is divided into filiform branches, emerging above the anthers.

Sphenostigma polycephalum Baker (Baker 1892: 107). Figures 11 and 12

Diagnosis: Plants ca. 40–60 cm high, bearing broad, flexuous and plicate leaves. Inflorescence is loose, some-



Figures 11 and 12. Tigridieae from Serra dos Pireneus, Goiás state, Brazil, *Sphenostigma polycephalum*. **11:** Inflorescence. **12:** Flower. Photos by F. Ilário and R. D. Sartin.

times pendant. The flowers are showy and completely yellow, very fugacious (opens in the morning and closes before the sunset), with fiddle-shaped anthers.

Ecology: This is a very rare species in the area, found only at Cachoeira das Araras. Occurs in small populations and blooms in the rainy season (December to January) with one or two flower at a time per plant.

Taxonomic note: The name “*Sphenostigma polycephala*” was created with grammatical error and is current

misused, since according to the International Code of Nomenclature (Articles 23.5 and 32.2) (McNeill et al. 2011), the specific epithet, when adjectival in form and not used as a noun, agrees grammatically with the generic name, in this case, neutral, making the correct name *Sphenostigma polycephalum*.

Selected examined material: Salles AH 2878 (HEPH 20115); Dantas-Queiroz MV 82 (UFG 46581).

Additional material examined: Sampaio AB s/n (CEN 44551); da Silva MA 4880 (CEN 41509); Salles AH 1809 (HEPH 7280); Rizzo JA 3272 (UFG 3872).

Tribe Trimezieae

Trimezia Salisb. ex Herb. (Salisbury 1812: 308; Herbert 1844: misc. 88).

Trimezia, with ca. 20 species, is distributed from Central to South America. Plants have a corm-like rootstock, leaves flat or cylindrical and inflorescences congested. Flowers are yellow, orange, blue or lilac; tepals unequal, with complex patterns of markings; outer tepals usually larger and reflexed, while the inner are smaller and usually erect and articulated. Stamens with filaments free and slender; styles are fused, except at stigmatiferous region, this with crests.

Trimezia cathartica (Klatt) Niederl. (Klatt 1862: 549; Niederlein 1890: 332)
Figures 13 and 14

Diagnosis: Plants ca. 15–30 cm high, bearing cylindrical leaves and a flowering stem with two imbricated bracts close or in the median region. Flowers are orange, with brown stripes from the claws to the median region of inner and outer tepals.

Ecology: This species comprises large populations, with many blooming plants at the same time, forming beautiful “natural gardens”. Blooming in the beginning of the rainy season (September to December), usually with one or two flowers at the same time per plant.

Selected examined material: Silva MA 6805 (CEN 72200); Arboz GF 6170 (HTO 3260); Rizzo JA 5643 (UFG 5693).

Additional material examined: Lolis SF 159 (UFG 46692); Moreto GL 01 (UB 5230); Oliveira FCA 85 (UB 6385); Rizzo JA 4567 (UFG 4036).

Trimezia juncifolia (Klatt) Benth. & Hook. f. (Klatt 1862: 549; Bentham and Hooker 1883: 690).
Figures 15–16

Diagnosis: Plants with variable heights, 10–160 [–250] cm. Their cylindrical leaves, with acute apex and the flowering stem without bracts (aphyllous), are the most distinctive feature. The flowers may vary from yellow to orange, rarely reddish, with brown stripes from claws to the median region of tepals.

Ecology: Large populations were observed, but may also occur isolated, usually close to forest formations. Blooming in the beginning of the rainy season (September to January), with one or two flowers at the same time per plant.

Selected examined material: Gomes-Klein VL 3175 (UFG 18863); Dantas-Queiroz MV 05 (UFG 46514).

Additional material examined: Skorupa LA 117 (CEN 14591); Vieira RF 1654 (CEN 23833); Ferreira HD 2666 (UFG 15838); Rizzo JA 7402 (UFG 7466).

Trimezia lutea (Klatt) R.C. Foster (Klatt 1871: 522; Foster 1962: 308)
Figures 17 and 18

Diagnosis: Plant ca. 30–50 cm high, bearing flat and linear leaves. Has a long bract in the flowering stem, exceeding the length of leaves. Flowers are pale yellow, with a short peduncle, usually sinuous. The styles are wider in the middle region

Ecology: Usually occurs isolated, not growing in large populations. Blooming in the rainy season (December to March), with only one flower at a time per plant.

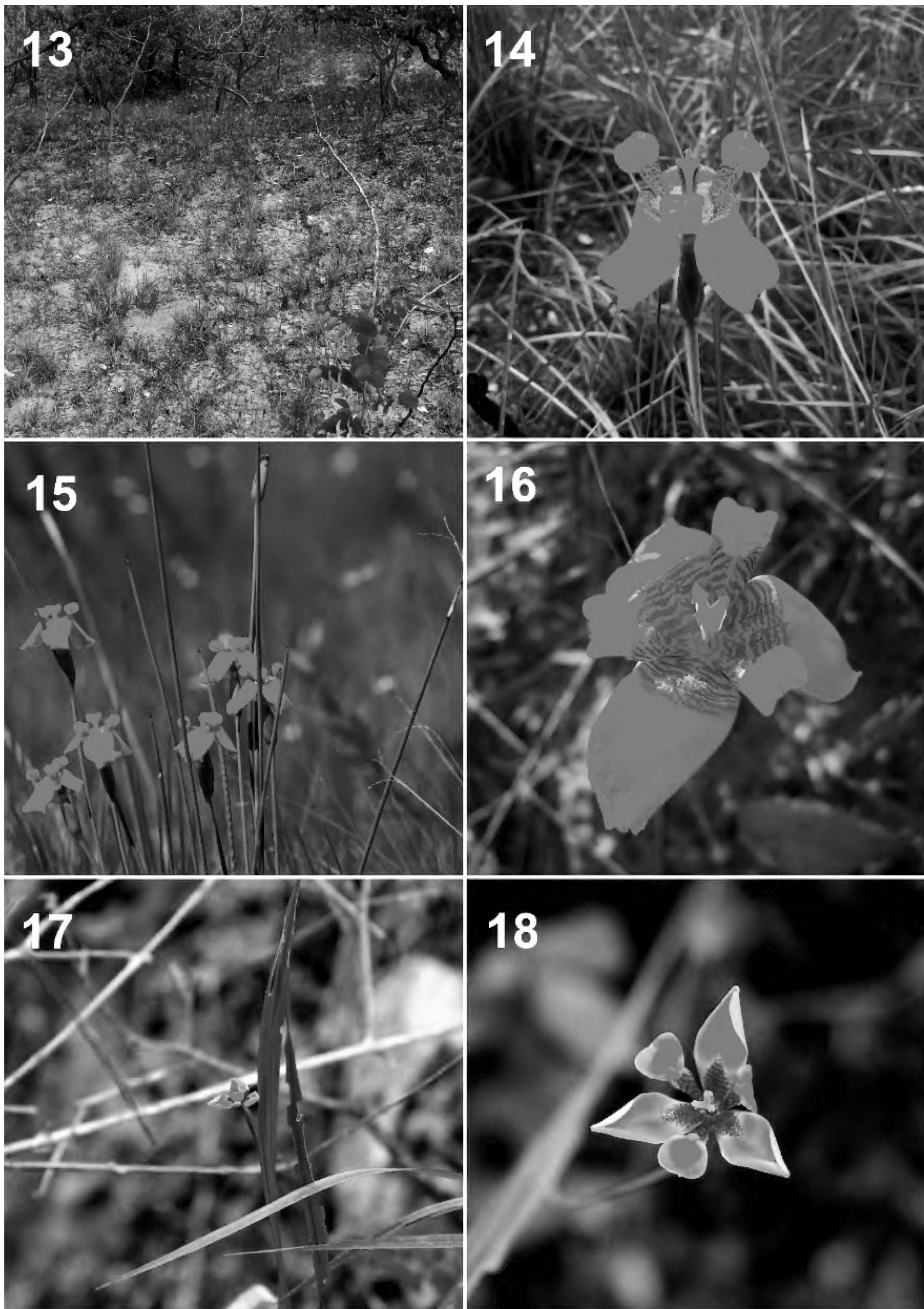
Selected examined material: Irwin HS 18760 (UB 122814).

Additional material examined: Pastore JFB 226 (CEN 50971); Pirani JR 1944 (CEN 37564); Alcântara MB 39 (UFG 15477); Gomes-Klein VL 2208 (UFG 18189).

DISCUSSION

Most of species of Iridaceae found in the SDP are consistent with the Brazilian Flora Checklist (Eggers et al. 2016). The species found in the SDP represent 32% of the 22 species found in the state of Goiás. However, according to Eggers et al. (2016), *Sisyrinchium marchio* was considered synonymous with *S. vaginatum* subsp. *marchio*. Regarding this taxon, all herbarium specimens seen were previously identified as *S. vaginatum*. We decided to follow the Eggers et al. (2016) because their indicated voucher specimen features a great resemblance to the specimens of SDP. However, this taxon has a complex taxonomy, shows wide morphological plasticity, and requires more detailed studies.

Another species with taxonomic problems is *Sphenostima polycephalum*. Ravenna (1977) held a series of new combinations, including some *Sphenostigma* species into *Gelasine*, *Cardiostigma* and *Ennealophus*; but *S. polycephalum* remained without a proper taxonomic characterization. Later, Chukr (2010) conducted a combination of *S. polycephalum* to *Alophia polycephala*, but not in accordance to the botanical nomenclature code because the author did not clearly indicate the basionym and the original valid publication. Therefore, *A. polycephala* remains a *nomen nudum* (McNeill et al. 2011). *Sphenostigma polycephalum* apparently is related



Figures 13–18. Trimezieae from Serra dos Pireneus, Goiás state, Brazil. **13** and **14:** *Trimezia cathartica*. **13:** Population. **14:** Flower. **15** and **16:** *Trimezia juncifolia*. **15:** Inflorescences. **16:** Flower. **17** and **18:** *Trimezia lutea*. **17:** Inflorescence. **18:** Flower. Photos by R. D. Sartin.

to *Alophia*, because both bear fiddle-shaped anthers but lack pollen grains with a verrucate aperture (Goldblatt and Le Thomas 1992; Goldblatt and Manning 2008; Dantas-Queiroz and Luz 2015). This species is in need of taxonomic revision to better establish its position and nomenclature.

Regarding the vegetation types, rocky fields had the greatest proportion of species (78%), followed by wet grassland (67%), open grassland (56%), dense grassland (44%), *Vereda* (33%), *Cerrado stricto sensu* and gallery forest (22%) and *Cerradão* (11%). These results were expected because, generally, Iridaceae species are well

adapted to field vegetation (Goldblatt and Manning 2008) and have underground storage organs, such as corms, bulbs and rhizomes, which allow plants to regenerate after fire (Rudall 1995; Almeida et al. 2015), a common phenomenon in this type of vegetation (Simon et al. 2009).

Despite being a small area, the SDP presented a representative number of species of Iridaceae, including the rare *Sphenostigma polycephalum*. As natural Cerrado areas are highly threatened and undergoing quickly being destroyed, biodiversity studies are extremely important for the preservation of this family and the ecosystem as a whole.

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